Oct. 4, 1960 H. EGGERDING 2,955,260

CONSTRUCTION OF ELECTRICAL DEVICES

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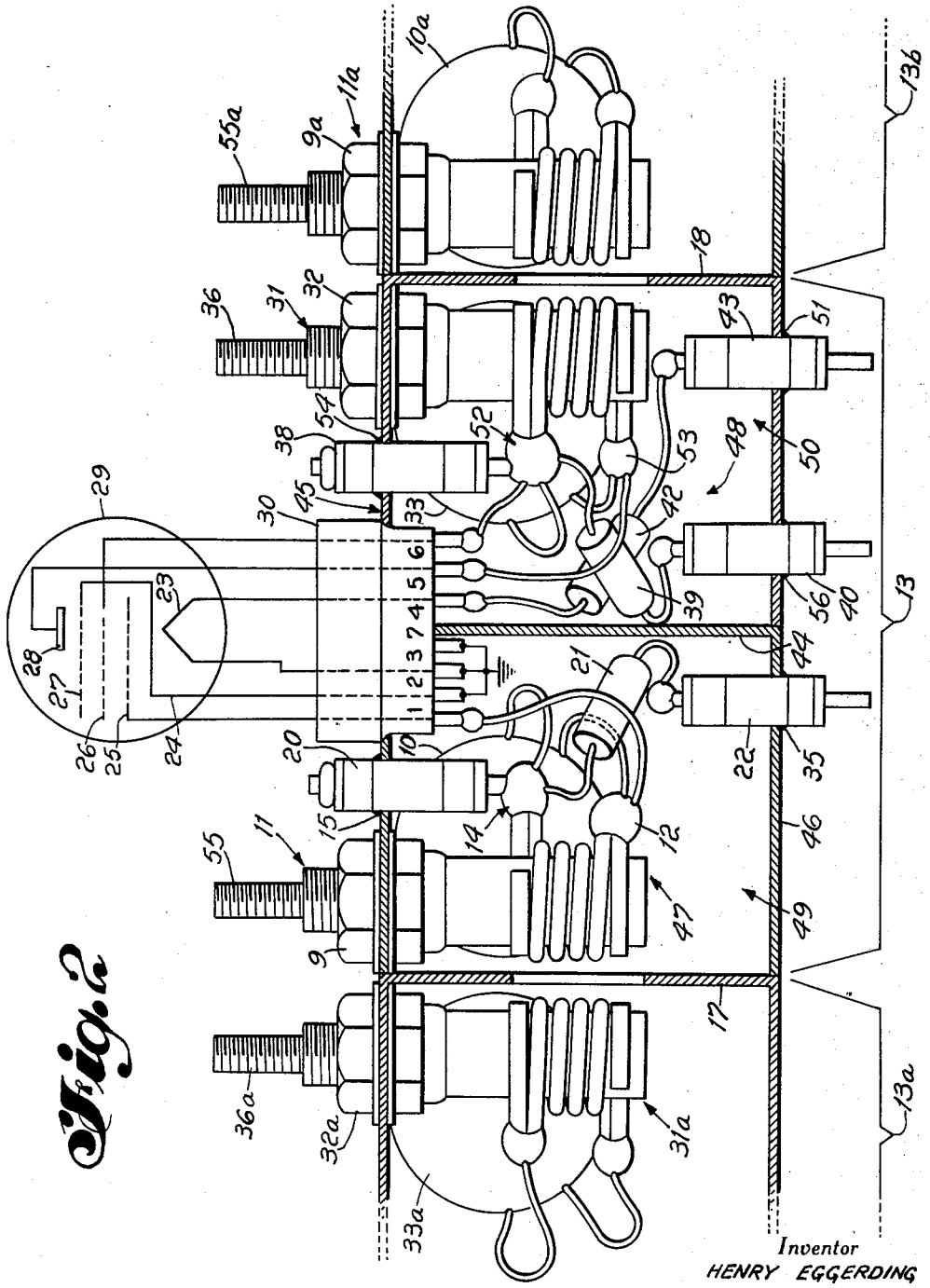


Fig. 2

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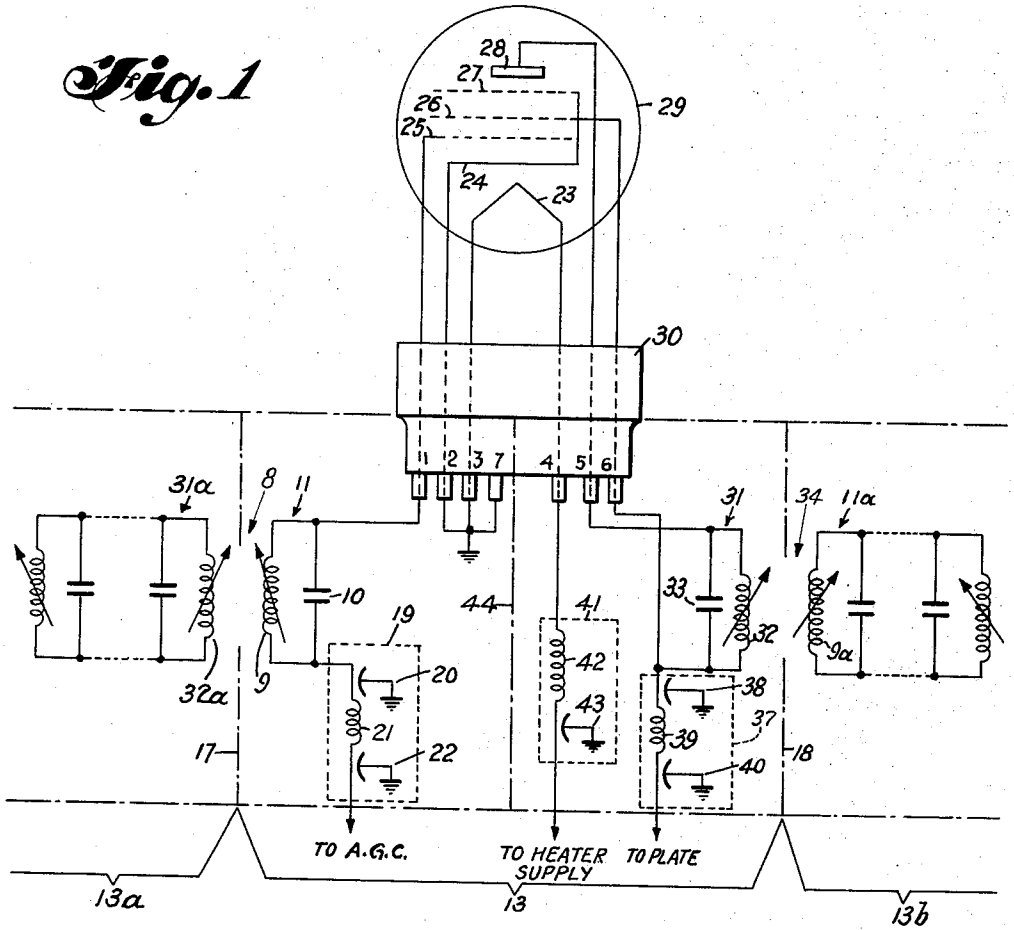
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Fig. 1



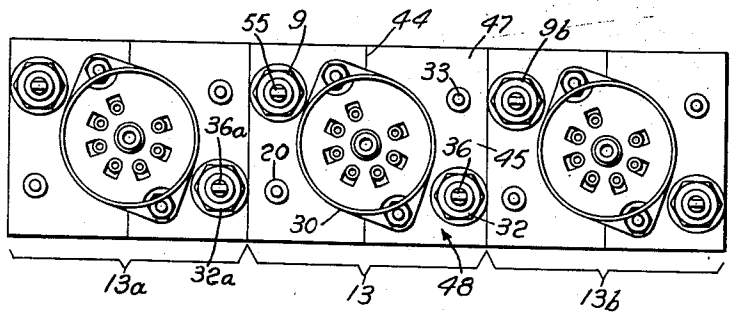


Fig. 3

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CONSTRUCTION OF ELECTRICAL DEVICES

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This invention relates to electrical apparatus and more particularly to a novel construction of electrical devices such as amplifiers, modulators, demodulators, mixers and the like.

The development of navigational and other electronic equipment in recent years has brought into existence complex electronic circuitry comprising many electronic devices. If such equipment is to have a reasonable degree of utility, it must be greatly compressed for installation in mobile craft, such as missiles and jet airplanes, where space is at a premium. In the past, navigational equipment has been designed with subminiature components in order to reduce the over-all size and weight of such equipment. However, it has been found that the use of such subminiature components yielded poor temperature stability due to high dielectric losses found in the capacitors and low values of electrical Q due to the low Q characteristics of the induction coils. Thus, a radically different method of construction is desirable which would reduce the over-all size of the navigational equipment, make the parts easily accessible and yet not decrease the accuracy of performance of such equipment.

An object of this invention therefore is to provide such a unit construction for electrical devices which satisfies the aforementioned needs.

Another object is the provision of an assembly of electrical devices in which a single electrical unit may be readily mechanically segregated and made available for test, repair, or replacement.

Another object is the provision of an improved means for shielding the parts in an electrical device.

In accordance with a feature of the present invention, there is provided an electrical device containing an input circuit, an output circuit, and an electron discharge device connected, for example, in the form of an IF amplifier. The device is enclosed in a casing for shielding purposes. The end walls of the device have openings contained therein to control the degree of mutual coupling between the input tank circuit of one electrical device and the output tank circuit of a similiarly constructed electrical device disposed adjacent thereto. The terminal connections of an electron discharge unit are connected to a ceramic socket member which is located in one wall of the electrical device. A shield is interposed between the terminal connections of the grid and plate connections of the electron discharge unit so as to prevent regenerative coupling between these connections.

Other and further objects and features of the present invention will become apparent with reference to the following description and drawings, in which:

Fig. 1 is a combined electrical schematic and sectional view of an assembly of electrical devices;

Fig. 2 is a longitudinal sectional view of an assembly of typical electrical devices; and

Fig. 3 is a top plan view of Fig. 2.

Referring to Fig. 1, there is shown an assembly of typical electrical devices **13**, **13***a*, and **13***b*. Electrical device **13** is in the form of an IF amplifier. Electrical

devices **13***a* and **13***b* may be regarded as amplifier stages for purposes of simplicity, although they may comprise different units if desired. In addition, as many of these electrical devices may be connected in tandem as are required. It is to be understood that the electrical device is not to be limited to the specific circuit shown here for illustration, but that it may employ many other types of electronic circuits such as detectors, modulators, etc.

The input tank circuit **11** of electrical device **13** is composed of secondary winding **9** of transformer **8** and capacitor **10** in parallel, and is tuned to an assigned intermediate frequency. Transformer **8** has its primary winding **32***a* connected as a part of the output tank circuit **31***a* of adjacent electrical device **13***a*. The output tank circuit of electrical device **13** is similar to the output tank circuit of electrical device **13***a*. Electrical device **13** is encased in a shielded enclosure except for openings present in its end walls **17** and **18**. The primary and secondary windings of transformer **8** are inductively coupled through the opening in end wall **17**, the size of this opening controlling the degree of mutual coupling between the two windings.

In addition, a decoupling network **19** is connected at the output of input tank circuit **11**, which is composed of capacitor **20**, acting as an RF return to ground, choke coil **21** and capacitor **22**. This network acts to attenuate the flow of IF signal to the AGC circuit and will allow the desired IF generated by the input tank circuit **11** to pass through to input grid **25** of pentode **29**. Pentode **29**, in the example shown, has a filament **23**, a cathode **24**, a first or signal input grid **25**, a screen grid **26**, a second control or suppressor grid **27** which is coupled to cathode **24**, and a plate **28**. Pentode **29** is inserted in a ceramic socket **30**. The elements of pentode **29** are connected to terminal posts **1** through **7** located at the lower portion of the ceramic socket **30**. Plate **28** is connected to terminal post **5**. The input and screen grids **25** and **26** are connected to terminal posts **1** and **6**, respectively. The suppressor grid **27** is tied into cathode **24** which is connected to terminal posts **2** and **7**.

The intermediate frequency signal potential derived from input tank circuit **11** is impressed upon input grid **25** via terminal post **1**. The output of pentode **29** is passed via plate **28** to terminal post **5**, where it serves to excite an output tank circuit **31** comprising a primary winding **32** of transformer **34** and a condenser **33** in parallel. Output tank circuit **31** is resonating at the assigned intermediate frequency, and is also connected between the terminal posts **5** and **6**. Primary winding **32** of transformer **34** is inductively coupled to secondary winding **9***a* in the input tank circuit **11***a* of adjacent electrical device **13***b*, which is similar to the input tank circuit **11** of electrical device **13**. Connected to output tank circuit **31** of electrical device **13** is decoupling network **37**, which is composed of condenser **38** acting as an RF return to ground, choke coil **39** and condenser **40**. This decoupling network **37** performs the same function as the aforementioned decoupling network **19** which, in this instance, prevents the flow of IF signal to the B+, and allows the generated intermediate frequency to pass through output tank circuit **31** to input tank circuit **11***a* found in adjacent electrical device **13***b*.

Filament **23** is connected to the terminal posts **3** and **4**. Connected to terminal post **4** is found another decoupling network **41** which is composed of choke coil **42** and capacitor **43**. This decoupling network acts to prevent the flow of IF signal to the filament supply circuits. Between terminal posts **4** and **7** is connected a shield **44** extending crosswise of the casing. This shield **44** acts to prevent regenerative coupling between the plate and grid connections of the terminal posts **1** through **7** located at the bottom of ceramic socket **30**.

Referring now to Figs. 2 and 3, there is illustrated an assembly of electrical devices wherein the electrical elements are all encased in a shielded enclosure which is utilized for mounting electronic components. For purposes of illustration the electrical devices **13**, **13***a*, and **13***b* are connected in the form of IF amplifiers. Electrical device **13** is composed of a top wall **45**, a base wall **46**, side walls **47**, **48** and end walls **17** and **18**. In the center of top wall **45** is connected a ceramic socket **30** having a pentode **29** mounted therein. In the bottom of ceramic socket **30** are connected terminal posts **1** through **7** which are utilized for the purpose of connecting the plate, cathode, and grid electrodes of pentode **29** to the circuit connections of the IF amplifier contained in electrical device **13**. The shield **44** is connected between terminal posts **4** and **7** to the walls **45**—**48**. This shield separates electrical device **13** into two sections, a left-hand section **49** and a right-hand section **50**.

Connected to top wall **45** of left-hand section **49** is input tank circuit **11**, composed of a slug tuned coil **9** having an adjustable control screw **55** to vary its inductance and a fixed tuning capacitor **10** soldered together at junctions **12** and **14**. Slug tuned coil **9** is located in the left-hand section **49** of top wall **45** and its primary winding is disposed adjacent to the opening in end wall **17**. The size of this opening will determine the extent of the mutual coupling between input tank circuit **11** of electrical device **13** and the output tank circuit **31***a* of adjacent electrical device **13***a*.

The output of fixed tuning capacitor **10** is connected to a decoupling network composed of feed-through capacitor **20** acting as an RF return to ground, choke **21**, and feed-through capacitor **22**. Feed-through capacitor **20** is mounted on wall **45** of left-hand section **49**. Feed-through capacitor **20** is held in wall **45** by a solder joint **15**. Connected to the inside terminal of feed-through capacitor **20** is an RF choke **21** which in turn is coupled to feed-through capacitor **22** which is soldered at junction **35** to base plate **46** of left-hand section **49**. In addition, the output of fixed tuned capacitor **10** is coupled to the input grid **25** of pentode **29** via terminal post **1** of ceramic socket **30**. The output of pentode **29**, which is fed via plate **28** to terminal post **5**, is coupled to output tank circuit **31** which is located on top plate **45** of right-hand section **50**. Output tank circuit **31** is composed of slug tuned coil **32** having an adjustable control screw **36** to vary its inductance and a fixed tuned capacitor **33** which is soldered at junctions **52** and **53**. Slug tuned coil **32** is mounted on top plate **45** of right-hand section **50**. The windings of slug tuned coil **32** are disposed adjacent to the opening in side wall **18**. The size of this opening determines the degree of coupling between the windings of slug tuned coil **32** and the windings of slug tuned coil **9***a* located in the input tank circuit **11***a* of adjacent electrical device **13***b*.

The output of fixed tuned capacitor **33** is connected to a decoupling network composed of feed-through capacitor **38** acting as an RF return to ground, RF choke **39**, and feed-through capacitor **40**. Feed-through capacitor **38** is mounted and soldered at junction **54** to top plate **45** and is located between ceramic socket **30** and slug tuned coil **32**. Connected to the inside terminal of feed-through capacitor **38** is RF choke **39** which is fed to feed-through capacitor **40** which is mounted on wall **46** at solder junction **56** of right-hand section **50**. Another decoupling network composed of RF choke **42** and feed-through capacitor **43** is connected between terminal post **4** and wall **46** of right-hand section **50**. Feed-through capacitor **43** is mounted and soldered at junction **51** on wall **46**. In addition, the shield **44** is connected between terminal posts **4** and **7** and walls **45**–**48**. This shield divides electrical device **13** into left and right-hand sections **49** and **50**, respectively. Shield **44** acts to prevent regenerative coupling between the plate and grid connections of the terminal

posts **1** through **7** located at the bottom of ceramic socket **30**.

In Fig. 3 the top view of the assembly of electrical devices is shown, the tuning screws **55** and **36** for tuning coils **9** and **32** being accessible from the top. In addition, the removal of the electron discharge device **29** from ceramic socket member **30** can easily be had. The removal and replacement of an electrical device, such as device **13**, can be readily achieved, requiring only subsequent retuning of slug tuned coil **32***a* of adjacent electrical device **13***a* and slug tuned coil **9***b* of adjacent electrical device **13***b*. Finally, the technique of shielding each electrical device, as previously described and shown in Figs. 1 and 2, and the technique of coupling the input and output circuits of adjacent devices results in a very compact assembly.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

I claim:

1. An electrical device comprising an input circuit, an output circuit, an electron discharge device having at least a cathode, anode and a control electrode, means to shield said input and output circuits comprising a severable first shielding casing having integral side walls, at least one end wall, and at least one open end, a second shielding casing having integral side walls, at least one end wall, and at least one open end, said open end of said second casing being disposed relative to said one end wall of said first shielding casing to enclose one of said circuits, shielding means disposed opposite said open end of said first shielding casing to enclose the other of said circuits, connection means commonly carried by adjacent side walls of said first and second casings to receive terminal connections of said electron discharge device, first circuit connections coupling said one of said circuits to certain of said terminal connections, second circuit connection coupling said other of said circuits to others of said terminals connections, said end wall of said first shielding casing being disposed between said terminal connections of said first circuit connection and said terminal connections of said second circuit connection to shield said input and output circuits one from the other.

2. An electrical device comprising a plurality of electrical networks, each of said electrical networks comprising an input circuit, an output circuit, and an electron discharge device having at least a cathode, anode and a control electrode, severable shielding means to shield each of said circuits, each of said shielding means comprising a severable first shielding casing having integral side walls, at least one end wall, and at least one open end wall, and at least one open end, said open end of said second shielding casing being disposed relative to said one end wall of said first shielding casing to enclose one of said circuits of an associated one of said networks, said end wall of said second shielding casing being disposed relative to an open end of a similar first shielding casing of a first adjacent one of said networks to enclose one of the circuits of said first adjacent one of said networks, and said open end of said first shielding casing being disposed relative to the end wall of a similar second shielding casing of a second adjacent one of said networks to enclose the other of said circuits of said associated one of said networks, connection means commonly carried by adjacent side walls of said first and second casing of each of said severable shielding means to receive terminal connections of said electron discharge device, first circuit connections coupling said one of said circuits of said associated network to certain of said terminal connections, and second circuit connections coupling said other of said circuits of said associated network to others of said terminal connections, said end wall of

said first shielding casing of each of said shielding means being disposed between said terminal connections of said first circuit connections and said terminal connections of said second circuit connection to shield said input and output circuits and their respective ones of said circuit connections one from the other.

3. An electrical device adapted to be assembled with other similarly constructed electrical devices as associated parts of an electrical network, each of said devices comprising an input circuit including a secondary winding of a first coupling transformer, an output circuit including a primary winding of a second coupling transformer, an electron discharge device having at least a cathode, an anode, and a control electrode, a severable shielding casing comprising at least a pair of severable first and second cells, each cell of said pair having as an integral part thereof sidewalls, at least one open end, and at least one end wall, said open end of said second cell being disposed relative to said end wall of said first cell being disposed relative to an end wall of an adjacent similar second cell to enclose the other of said circuits, connection means commonly carried by two adjacent sidewalls of said pair of cells to receive the terminal connections of said electron discharge device, first circuit connections coupling said one of said circuits to certain of said terminal connections, second circuit connections coupling said other of said circuits to others of said terminal connections, said end wall of said first cell being disposed between said terminal connections of said first circuit connection and said terminal connections of said second circuit connection to shield said input and output circuits and their respective ones of said circuit connections one from the other, said end wall of said second cell being disposed between the windings of the coupling transformer associated with said one of said circuits enclosed therein and including therein an opening to provide inductive coupling between the windings of the coupling transformers associated with said one of said circuits, and said end wall of said adjacent similar second cell being disposed between the windings of the coupling transformer associated with said other of said circuits enclosed in said first cell and including therein an opening to provide inductive coupling between the windings of the couplings transformers associated with said other of said circuits.

4. An electrical device adapted to be assembled with other similarly constructed devices as associated parts of an electrical network, each of said devices comprising an input circuit including a secondary winding of a first coupling transformer, an output circuit including a primary winding of a second coupling transformer, an electron discharge device including at least a cathode, an anode and a control electrode having terminals associated therewith, a severable shielding casing comprising a first severable shielding cell, a second severable shielding cell, said first and second severable shielding cells each having sidewalls, an end wall and an open end, the open end of said second cell being disposed relative to the end wall of said first cell to enclose said output circuit, the open end of said first cell being disposed relative to the end wall of an adjacent second cell of a similar shielding casing to enclose said input circuit, a socket carried jointly by two adjacent sidewalls of said first and second cells to receive said terminals, first circuit connections connected to said socket to couple said input circuit to certain of said terminals, second circuit connections connected to said socket to couple said output circuit to others of said terminals, said end wall of said first cell being disposed between said terminal connections of said first circuit connections and said terminal connections of said second circuit connections to shield said input and output circuits and their respective ones of said circuit connections from each other, the end wall of said second cell being disposed between the windings of said second coupling transformer and including therein an opening to provide inductive coupling between the windings of said second coupling transformer, said end wall of said adjacent second cell being disposed between the windings of said first coupling transformer and including therein an opening to provide inductive coupling between the windings of said first coupling transformer.

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